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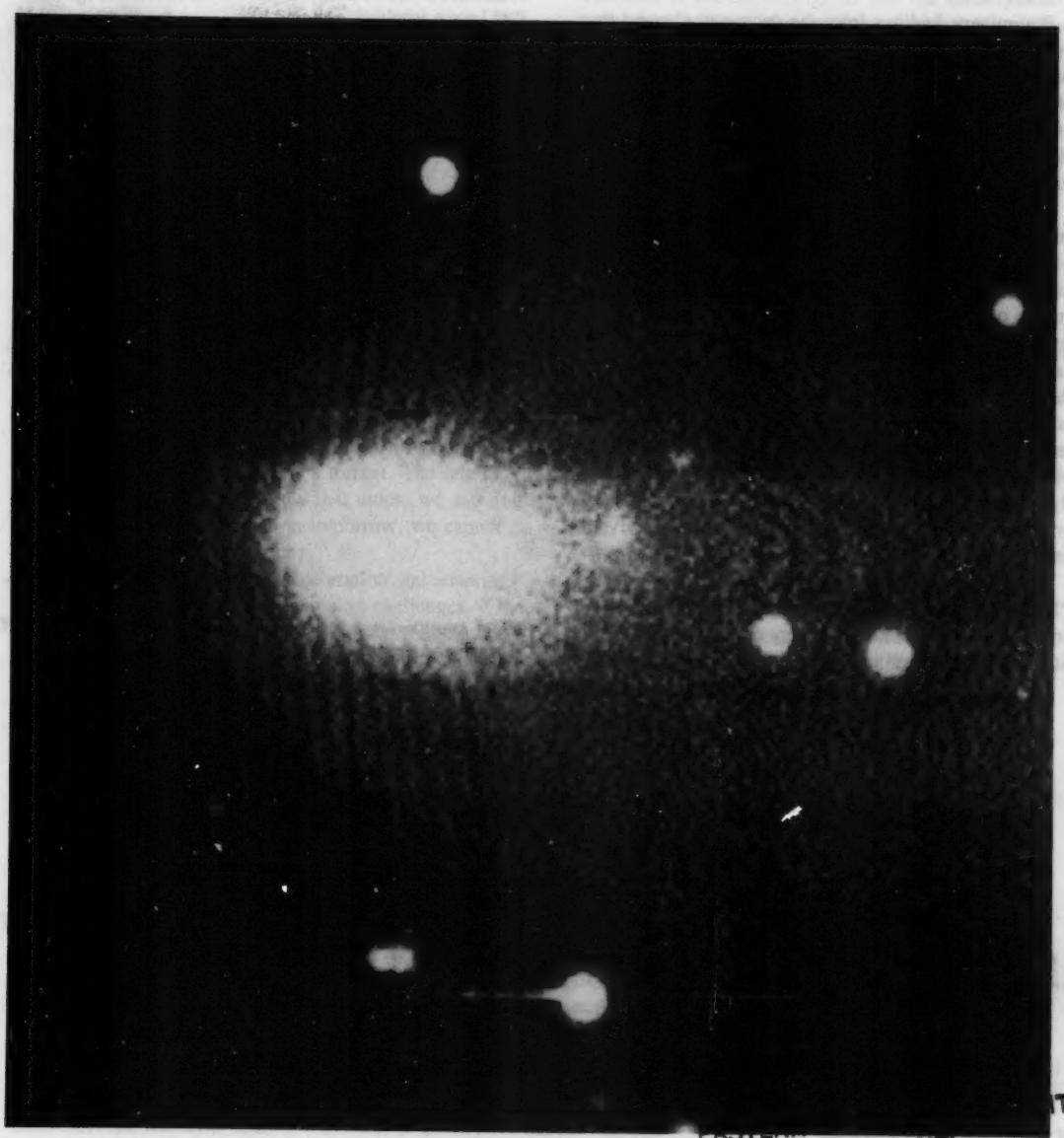

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About the Cover

Comet Giacobini-Zinner was photographed by the Kitt Peak National Observatory, Tuscon, Arizona, on September 11, 1985 as NASA's International Cometary Explorer (ICE) encountered the comet 44-million miles from Earth.

ICE entered the 14,000 mile-wide tail of the comet, 4,900 miles behind the cometary nucleus at approximately 6:50 a.m. EDT. Traveling at 46,000 miles-an-hour, ICE emerged from the tail approximately 20 minutes later.

Preliminary findings from the encounter showed that many predicted features of the comet's makeup were confirmed. One confirmed theory was that the comet's plasma tail was threaded by hairpin-shaped, magnetic-field lines captured from the solar wind, with its electrified gases both denser and colder than those of the surrounding solar wind.

However, one newly-found phenomenon puzzled scientists. They discovered that at least 300,000 miles before ICE reached the comet, the spacecraft detected high-speed, heavy-ion beams (made up of electrified atomic or molecular particles) never before found in space.

Another finding showed that the comet did not have the sharply-defined bow shock. Instead the comet was preceded by a broad, U-shaped, turbulent interaction region as it plowed through the solar wind of interplanetary space. Also, the dust hazard associated with flying through the tail of the comet was less than originally thought, enabling the spacecraft to survive the encounter.

The mission, managed by NASA's Goddard Space Flight Center, represented the world's first spacecraft encounter with a comet in history and gave the United States another "first" in space exploration.

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Administrator's Column

(In this column, NASA Activities features an article by NASA Administrator James Beggs. These articles focus on subjects chosen by him that address topics of broad interest to the agency's employees. The column this month features an address presented to the California Museum of Science and Industry dinner, Los Angeles, California.)

Note: *The speech appearing in the Administrator's Column (October issue) was delivered at NASA's Ames Research Center, not at Town Hall of California.*

The Rate Of Change

Some 2500 years ago, the Greek philosopher, Heraclitus, taught that there is no permanent reality except the reality of change. As he put it, "You cannot step twice into the same river."

In Heraclitus' day, the river of change was a slowly meandering stream. Today, it is a torrent. The rate of change is accelerating so rapidly that unless we can find some way to keep our sights on tomorrow, we cannot expect to be in touch with today.

Indeed, understanding this acceleration and adapting to it has become one of the consuming challenges of the modern age. It is a challenge of enormous magnitude. Sir George Thomson, the British physicist and Nobel laureate, believed the nearest historic parallel was the invention of agriculture in the Neolithic Age. Other authorities find that the effects of the technological revolution we are experiencing will be deeper than any social change we have ever undergone.

The rapid pace of scientific and technological change has become so much a part of our lives that we tend to take it for granted. Change has entered our lives so quickly and so quietly that marvels of science themselves have made science seem less marvelous. And as humanity's capacity for awe diminishes, humanity, too, could be diminished.

We can't afford to let this happen. For, if we lose our sense of wonder at what we have achieved, we are in danger of quenching the spark within that motivates us to continue to ascend to new plateaus of knowledge and accomplishment.

Every so often we need to remind ourselves that science and technology have moved us further faster than in any period in human history.

Time was, for example, that we gazed at the stars and wondered at their eternal mysteries. Today we are probing the heavens and slowly, but surely, the stars are yielding their secrets. Indeed, we have found that some may even have solar systems in varying stages of formation. For the first time, we have walked on another heavenly body. And we have sent automated extensions of human intelligence into the solar system and beyond, billions of miles from our own planet from which they evolved so suddenly.

Today, we look back at the Wright Brothers' first, faltering flight at Kitty Hawk and recognize that its entire distance was no greater than the wing span of a 747 transport. In just 78 years, a human lifespan, we soared from the dunes of Kitty Hawk to the routine access to space we enjoy today with the Shuttle, in which we orbit the Earth every 90 minutes at close to 18,000 miles an hour.

We have come a long way, indeed. And our pace is accelerating.

When recorded human history began around 6,000 B.C., the fastest transportation over long distances was the camel caravan, which moved at eight miles an hour.

It took 4,400 years for the chariot to raise man's speed to 20 miles an hour and 3,400 more years before second generation steam locomotives surpassed that speed. In 1880, an advanced locomotive managed to attain a speed of 100 miles an hour.

But by mid-1950s turboprop airplanes had quadrupled that figure and two decades later, jet aircraft had far surpassed it. During the 1960s, men in space capsules orbited the Earth at close to 18,000 miles an hour and, in the late 1960s and early 1970s, travelers to the moon at nearly 25,000 miles an hour.

Some 50,000 years ago, the first creatures indistinguishable from modern men and women began to appear on Earth. If we were to divide modern man's existence on Earth into lifetimes of about 62 years each we begin to get a pretty dramatic idea of how the rate of change has accelerated.

There have been approximately 800 such lifetimes, about 650 of which were spent in caves or other primitive shelters.

Only during the last 70 lifetimes has writing made it possible to communicate effectively from one lifetime to another.

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Only during the last six lifetimes have masses of people ever seen a written word.

Only during the last four lifetimes has it been possible to measure time with any precision.

Only within the last two lifetimes has anyone, anywhere, used an electric motor.

Only within the last two lifetimes, have we developed the overwhelming majority of material goods we use, and most of the means to combat age-old diseases.

And only within this most recent lifetime have we seen our understanding of the Earth, the solar system and the Universe mushroom at a fantastic rate. Indeed, within the past 26 years, we have learned more about ourselves and our place in the Universe than in any other period of history.

I am proud that NASA and our predecessor, the National Advisory Committee for Aeronautics have played a key role in promoting these changes and advancing our understanding of their implications in our century.

For more than 70 years, we have pushed forward the frontiers of science and technology on Earth, in the air and in space. In so doing, we have helped to advance American technological leadership and spurred our economy on to greater growth and progress, while bringing untold benefits to people everywhere.

Indeed, I often say the benefits of research and technology are hard to measure, but impossible to question. Tens of thousands of spin-offs and applications of aerospace research are bettering life for people everywhere. They range from programmable heart pacemakers and other implantable medical devices to new alloys, fire-fighting equipment and traffic control systems.

Robert H. Goddard, the father of American rocketry once said: "Real progress is not a leap in the dark, but a succession of logical steps."

And so it has been and will continue to be with our space program.

The manned space program evolved from sub-orbital and orbital flights in cramped capsules to the Shuttle, in which astronauts fly in shirt-sleeved comfort and return to Earth on aircraft runways.

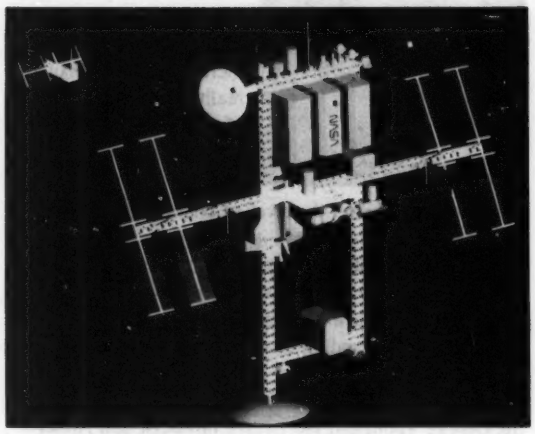
The early balloons and basketball-sized satellites have grown into sophisticated orbiting spacecraft that monitor weather, climate and Earth resources, assist navigation and, by pinpointing distress signals on Earth, help to save lives. By the same token, our early, scientific spacecraft have rapidly become more complex and are returning a rich harvest of imagery and data from the solar system, the galaxies and the Universe.

Our space program has taught us that just as there are no limits on our aspirations, so, too, can there be no limits on our reach, given the will and resources to cross new frontiers.

We are now flying the Shuttle once a month. By 1988, with our four-orbiter fleet, we expect to double that flight rate to 24 missions a year. Our schedule will take us over the 100-mission mark by 1989. And we believe we will maintain or better that flight rate through the end of the century.

By the mid-1990s, when our Space Station will be open for business, we will be living, working and learning in space on a permanent basis. The President has called the Space Station our next logical step in space. And, indeed, it is, because it will give us the chance to do things in science, in commerce, and in industrial research that we never dreamed possible at the dawn of the space age.

With the Space Station, we will be able to exploit three unique attributes of space; its magnificent vantage point for observing the Earth and the Universe; its microgravity environment and the pure vacuum created in the wake of spacecraft.



The "dual keel" concept of the Space Station.

These features offer unlimited opportunities for scientific and technological progress, not only for ourselves, but for our friends in Europe, Canada and Japan, with whom we expect to be partners in the Station's development and use.

For example, on the Space Station we could manufacture medicines that could enhance dramatically the treatment of such diseases as cancer and diabetes; grow pure crystals for electronics uses and make new alloys for a wide application of industrial use on Earth.

The Space Station will give us a permanent laboratory in orbit to investigate the effects of microgravity on the physical processes and on the human body. It will provide us with a permanent base for science in orbit, a

magnificent vantage point to study the Earth, the solar system and the Universe.

A most important use for the Space Station will be to serve as a repair and maintanance facility for satellites, a service station if you will, to increase satellites' lifetimes and utility. Our dramatic satellite repair and rescue missions foreshadow, in a small way, the kind of operations that will become routine with the Space Station.

Finally, and perhaps, most important, the Space Station could be the springboard for other, more ambitious missions, a manned lunar base, or a manned journey to Mars or to the asteroids. It could serve as our way station to the stars.

Shakespeare wrote: "The time of life is short; to spend that shortness basely were too long."

The time of life is indeed, short. And we have learned in this century that to bring our dreams alive we must work fast and we must give it all we've got. Because only then can we keep in touch with today and meet tomorrow with confidence.

Our high adventure in space is a challenge that goes to the heart of one of the noblest of human aspirations: the pursuit of knowledge toward the purpose of peace and human benefit.

More than half of century ago, Albert Einstein made a speech at the California Institute of Technology which summed up that challenge more eloquently than I ever could. He said: "It is not enough that you should understand about applied science in order that your work may increase man's blessings. Concern for man himself and his fate must always form the chief interest of all technical endeavors . . . in order that the creations of our mind shall be a blessing and not a curse to mankind."

Einstein's advice is even more important today, in this fast moving, ever-changing and increasingly complex world. And I believe that as free men and women, each of us, in our own way, has an obligation to be guided by it, in thought as well as action.

The wonders of scientific discovery, the benefits of new technology and the joy of pushing forward the knowledge frontier, all are the fruits of freedom. Those fruits are sweet, indeed. They help to keep the American Dream alive, here at home and thoughout the world.

Keeping that dream alive, nourishing what Abraham Lincoln called "humanity's last best hope on earth", is the greatest gift we can give our children and future generations.

Our young people are the trustees of the American Dream. They will both shape and inherit the future. If we can continue to feed their insatiable hunger for knowledge and continue to motivate them to expand their horizons, we will have given them and our country a priceless gift indeed.

Educational Plans For Shuttle Mission 51-L Announced

Live lessons to classrooms around the country and scientific demonstrations filmed for use in educational products are just some of the activities that will be involved with Shuttle Mission 51-L and the flight of the first Space Flight Participant.

Christa McAuliffe, the finalist in the NASA Teacher in Space Project, along with Barbara Morgan, the back-up candidate, reported to NASA's Johnson Space Center, Houston, on Sept. 9 to begin training which will continue until the flight of 51-L now set for launch no earlier than Jan. 22, 1986.

NASA is making plans for a direct satellite broadcast and schools will be able to observe lessons from space.

The first live lesson entitled "The Ultimate Field Trip" will allow students to compare daily life on the Shuttle with that on Earth. McAuliffe will take viewers on a tour of the Shuttle, explaining crewmembers' roles, showing the location of computers and controls and explaining experiments being conducted on the mission. She also will demonstrate how daily life in space is different from that on Earth in the preparation of food, movement, exercise, personal hygiene, sleep and the use of leisure time.

The second lesson called "Where We've Been, Where We're Going" will help the audience understand why people use and explore space by demonstrating the advantages of manufacturing in the micro-gravity environment, highlighting technological advances that evolve from the space program and projecting the future of humans in space.

Also during the 51-L mission, McAuliffe will be involved in several activities which will be filmed and later used in educational products. Potential activities include:

- **Earth Magnetism**—Photograph and observe the lines of magnetic force in three dimensions in a microgravity environment.
- **Newton's Law**—Demonstrate Newton's first, second and third laws in microgravity.
- **Bubbles**—Understand why products may or may not effervesce in a microgravity environment.

- **Space Expressions**—Generate from students creative works that reflect their interpretation of the space program/experience.
- **Simple Machines/Tools**—Understand the use of simple machines/tools and the similarities and differences between their uses in space and on Earth.
- **Hydroponics in Microgravity**—Show the effect of microgravity on plant growth, growth of plants without soil (hydroponics) and capillary action.
- **Chromatographic Separation of Pigments**—Demonstrate chromatography in a microgravity environment and show capillary action (the mechanism by which plants transport water and nutrients).

The educational emphasis on Shuttle Mission 51-L will be further enhanced with a program now in its 6th year at NASA. Three Shuttle Student Involvement Project experiments will fly onboard the Shuttle and McAuliffe will assist the mission specialists in conducting them. The experiments deal with using a semipermeable membrane to direct crystal growth, studying chicken embryo development in space and the effect of weightlessness on grain formation and strength in metals.

Water May Have Played Major Role On Mars

Ice, snow, flowing rivers and vast lakes may have played a major role in shaping the ancient Martian surface and climate, a panel of scientists reported at NASA's Ames Research Center.

Their scientific presentation grew out of research discussed at the "Water on Mars Workshop," which brought 83 scientists to Ames last winter and included more recent work in this active field.

Early in the planet's history, according to Bruce Jakosky of the University of Colorado, Boulder, the Martian poles were tilted more directly toward the Sun than they are today. As a result, the polar ice caps may have sublimed (changed directly from a solid to a gaseous state) into the atmosphere during the continual daylight of polar summer.

Vapor from the caps would have been carried by Martian winds to the equatorial regions. At equatorial latitudes, where night always alternates with day, the chill of nightfall would have precipitated water vapor as snow, Jakosky said.

Gary Clow of the U.S. Geological Survey, Menlo Park, Calif., reported that an equatorial snowpack could have been heated by sunlight trapped inside the snow fields. A reflective, insulating blanket of snow can trap sunlight, much as a greenhouse holds the Sun's warmth. Thus, even if the surface of Mars had still been cold, melting beneath an insulating snowpack could have let water escape to carve the "valley network" channels of Mars. These valley network channels as well as larger outflow channels—both strongly resembling dry riverbeds on Earth—were photographed by Mariner 9 in 1972.

The larger outflow channels are thought to have been created by sudden release of enormous amounts of subsurface water, which may have dug the channels in a matter of weeks. The valley network channels, which Clow has studied, are smaller and indicate the existence of a more moderate climate on early Mars, allowing liquid water to flow for long periods of time.

Huge ice-covered lakes also may have existed on the ancient Martian surface in the immense Valles Marineris canyon system, according to Steven Squyres of Ames. Viking photographs of the floor of these canyons, Squyres said, reveal thin, flat-lying layers of sediments which appear to have been laid down in standing bodies of water.

Today, Mars is so cold that all water on its surface freezes. Although the Martian atmosphere is 95 percent carbon dioxide (an effective infrared absorber), it is so thin that it cannot trap the heat of the Sun.

Dry ice (solid carbon dioxide) covers the polar regions of Mars. Water-ice lies underneath the northern cap and perhaps under the southern polar cap as well. The water-ice at the northern pole is revealed when the overlying dry ice vaporizes each summer.

Water-ice in the Martian polar caps does not melt because temperatures rarely climb above freezing, except at the equator. It sublimes directly into the atmosphere, forming wispy clouds on Mars. Earth's billowy clouds are formed by tiny droplets of liquid water.

Today, ice is present in the Martian ground in regions above 30 degrees latitude, according to Squyres and Michael Carr of the U.S. Geological Survey. Examining Viking photographs of impact craters, Squyres and Carr found evidence of "terrain softening", a rounding off of features indicating water activity beneath the surface.

Terrain softening of smaller, more recent craters suggests that ice remains present in these northern and southern regions. Like the tundra of Alaska, this deeply-frozen ground never thaws.

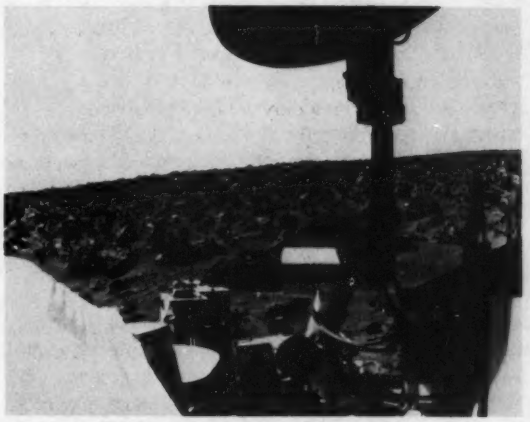
The presence of ice indicates that liquid water exists deep within the planet, according to Carr. Half a mile beneath the surface, water in the pores of Martian rocks is liquid, Carr says. It is heated by the high temperatures present at these depths in the Martian crust.

Robert Haberle of Ames, studying water distribution on Mars using data gathered by Viking orbiters, has found that water lost by the north polar cap during summer is not fully recovered in the winter. He wants to determine where this water goes.

Movement of water and carbon dioxide to and from the polar ice caps and movement into and out of the rubbly Martian ground may be responsible for the mysterious "layered terrains" that fringe the polar caps.

In winter, carbon dioxide condenses over the polar region, depositing a layer of mingled ice and dust. This layer then becomes cemented into place by water-ice and remains when the carbon dioxide evaporates again in the spring. Periodic changes in the Martian climate, caused by fluctuations in the planet's tilt toward the Sun, can alter the amount of gas which condenses, thus creating layers of varied sizes.

According to James Pollack of Ames, the Martian climate in the past may have been warmer and wetter. An earlier atmosphere may have been much thicker with more carbon available to hold the Sun's warmth. Rivers and lakes of liquid water could have dotted the ancient landscape.



The Mars surface photographed by the Viking I Lander.

This earlier, warmer climate actually may have destroyed itself, Pollack says. The presence of liquid water would have accelerated weathering of rocks, enhancing chemical reactions that take carbon dioxide out of the atmosphere and incorporate it into minerals. With the loss of carbon dioxide from its atmosphere, heat would have escaped the planet's surface, cooling the planet and locking up its water as ice.

However, not all scientists accept this theory on how Mars lost its originally-thick atmosphere. A new theory, suggested at the workshop by Peter Schultz of Brown University, is that the cataclysmic impact, that created the immense Argyre basin on Mars, may have perturbed its climate by blowing into space a significant part of the atmosphere. Schultz noted that Martian terrains, formed after the Argyre impact, have fewer dry channels than older terrain, a feature that suggests a major climatic change at that time.

Besides Earth, Mars is the only planet in our solar system that experiences cyclical changes in climate. Understanding past and present conditions on Mars will help scientists decipher Earth's climate, said Haberle.

Medical Doctors See Potential Of Remote Sensing Technology

Doctors from Washington University Medical Center in St. Louis, Mo., see promising potential for using NASA remote sensing techniques to enhance the medical profession's present capabilities to detect disease.

Last month a team of three physicians met with NASA scientists at NSTL for the first in a series of visits to learn to apply this technology as an analytical tool for use in a relatively new field of body scanning known as nuclear magnetic resonance, or NMR.

The project, which began in April, is a three-year collaborative effort between the Mallinckrodt Institute of Radiology in St. Louis, NSTL and the Kennedy Space Center.

Already the NMR has been used on a number of organ systems in the brain, according to Dr. Michael Vannier, radiologist and principal investigator for the project. However, most recently the National Cancer Institute has become interested in the effort to determine how magnetic resonance imaging fits into the scope of breast diagnostic techniques. Accompanying Vannier on behalf of the Breast Imaging Project sponsored by the cancer institute were Doctors John Gohagan and Ed Spitznagel, also of Washington University.

The union with NASA is vital to maximize the potential of NMR scanning, according to Vannier. He said, "One of the characteristics of these magnetic resonance scanners is that they provide very specific anatomic information about the location and size of a tumor. However, there are other ways to get the same information, one being the use of a mammogram, or breast X-ray."

At NSTL, scientists Doug Rickman and Jim Anderson are responsible for applying the analytical capabilities to make NMR scans a notable advancement over other methods of X-ray and body scanning techniques. Rickman and Anderson have successfully demonstrated the use of ELAS software to enhance the NMR images

in such a way as to increase disease detection accuracy.

Vannier explained, "No one in medicine really has the kind of experience with classifying or analyzing these types of images this way. That's why we are using NASA expertise to help us."

By incorporating into the system the ELAS software used in processing satellite imagery, NMR scans can provide not only information on the location and size of a tumor, but also its biological behavior. In other words, the status of a mass of tumor can be determined directly from the NMR image without having to enter the body surgically.

Vannier added, "What we expect this type of technology to do is to help us answer a lot of very specific questions that influence the management of patients."

Close affiliation with pathologists while working on these actual cases is important in determining whether there has been misclassification on the image processing machines, according to Gohagan.

He said, "Our goal is to ultimately get the kind of discrimination necessary to distinguish different anamolous conditions." For example, blood clots will appear distinctly different from benign tumors, and a marked difference will be evident between benign and malignant tumors.

According to Vannier, as a result of this collaboration an improvement will evolve in the way NMR images are acquired. He said, "I think it will have significant influence on what we do in the future."

Payload Specialists For Comet Halley Mission Selected

NASA announced the selection of payload specialists for Space Shuttle mission 61-E, an ultraviolet astronomy mission known as "Astro-1," scheduled for launch March 6, 1986.

Dr. Samuel T. Durrance, associate research scientist in the Department of Physics and Astronomy, Johns Hopkins University, Baltimore, and Dr. Ronald A. Parise, manager of Advanced Astronomy Programs, Computer Sciences Corp, Silver Spring, Md., were selected to fly the mission, which will perform Halley's Comet observations.

Dr. Kenneth H. Nordsieck, associate professor at Washburn Observatory, University of Wisconsin, Madison, will serve as backup in the event either Durrance or Parise cannot participate in the flight. As an alternate payload specialist, Nordsieck will oocupy a principal position in the Payload Operations Control Center at the Marshall Space Flight Center, Huntsville, Ala., during the mission.

The payload specialists are experienced astronomers, which is considered crucial to the mission since they will make decisions to ensure the best possible scientific data return.

The Astro-1 mission will study Halley's Comet and many other celestial objects through three ultraviolet astronomical instruments. In addition, a special visible-light wide field camera has been incorporated into the payload to augment the Halley's Comet studies.

Each payload specialist is a member of one of three science teams that developed the ultraviolet instruments. Payload specialists Durrance and Parise will operate the ultraviolet instruments, while astronaut mission specialists will operate the Instrument Pointing System (IPS), on which the three instruments are mounted. Designed for precise aiming at celestial targets, the IPS was developed by the European Space Agency and flew initially on the Spacelab 2 science mission in early August.

The Astro-1 flight is scheduled to coincide with the Halley encounter missions by the European Space Agency, the Soviet Union and Japan. Dr. Burton I. Edelson, NASA associate administrator for Space Science and Applications, said: "The opportunities for science synergism between Astro-1 and the armada of Halley encounter spacecraft are significant. The scientific study of Halley's Comet will be an internationally coordinated effort."

The Astro-1 complement of scientific instruments is well suited for the study of a wide variety of other celestial objects in addition to Halley's Comet. The complement consists of the Hopkins Ultraviolet Telescope, which will study faint astronomical objects such as quasars, active galactic nuclei and normal galaxies in the far ultraviolet range; the Ultraviolet Imaging Telescope, which will record image-intensified photographs of faint objects such as hot stars and galaxies in broad ultraviolet wavelengths and with a wide field of view; and the Wisconsin Ultraviolet Photopolarimetry Experiment, which will study the polarization of hot stars, galactic nuclei, and quasars. Together, these instruments will make 200 to 300 observations during the Astro-1 mission, the first of three in a series scheduled for launch within the next 2 years.

From The Congressional Record . . .

(Chairman Don Fuqua introduced the Federal Science and Technology Revitalization Act of 1985 and provided the following remarks.)

I am introducing the Federal Science and Technology Revitalization Act, which would establish an alternative personnel management system for scientific and technical people in the federal government. This is something I have been interested in for a long time, amd I am hopeful that the proposal I am introducing will be able to help improve the quality of government-operated federal laboratories by encouraging the recruiting and retention of highly qualified scientific and technical individuals.

The major provisions of the bill will:

- Permit agencies to include scientific and technical personnel in the new personnel management systems;
- Simplify job evaluation and remove covered positions from the classification requirements of 5 U.S.C., Chapter 51;
- Provide flexibility to develop a salary structure which ensures a competitive position in the labor market and which reflects the hiring and pay policies needed to attract, retain, and motivate a highly qualified scientific and technical work force;
- Base pay increases on performance, not longevity;
- Allow waiver of the pay cap for up to 5 percent of specially qualified scientific and technical personnel;
- Provide for performance and special awards and remove the pay cap for lump-sum awards, and
- Create a Senior Scientific and Technical Personnel Service.

No employee's basic pay would be reduced as a result of being included under an alternative personnel management system.

In May 1983, the Federal Laboratory Review Panel of the White House Science Council, chaired by David Packard, reported that federal laboratories have several serious deficiencies and, consequently, a number of the laboratories do not meet the quality and productivity standards that can be expected of them.

Specifically, the panel reported that salaries at federal laboratories are noncompetitive with the private sector at entry and senior levels. In addition, it found that federal laboratories must deal with a personnel management system that is cumbersome and has little flexibility.

As a result, there exists what the panel referred to as an alarming "inability of many federal laboratories—especially those under civil service constraints—to attract, retain, and motivate qualified scientist and engineers." This situation, warned the panel, limits the productivity of the laboratories and, if not corrected, will seriously threaten their vitality. As the panel observed in its report, "the key to a laboratory's success is a high quality and properly motivated scientific staff."

The panel concluded that administrative and legislative actions should be initiated to create, at government-operated laboratories, a scientific/technical personnel system that is independent of current civil service personnel systems.

The bill is the legislative attempt to deal with these very real problems. The bill has been drafted to provide authority for agencies to construct alternative personnel systems appropriate to the scientific and technical personnel employed by the federal government. The legislative does not attempt to define the specific agency personnel systems beyond establishing some general guidelines. It is believed that this approach will provide the government the greatest flexibility in dealing with a very complex problem.

My own experience, gained from both constituent service and committee work, is that the requirements for NASA and Department of Agriculture labs may be very different, but attracting and retaining quality personnel is absolutely essential for the space program and for emerging fields in agriculture.

In spirit, the model legislation is very similar to the demonstration project section (5 U.S.C. 4703) of the Civil Service Reform Act of 1978. The model legislation provides the Office of Personnel Management and the agencies the authority to develop alternative personnel systems for scientific and technical personnel at federal laboratories and, under appropriate conditions, outside of federal laboratories.

These systems can be tailored to the peculiar needs of a given agency or of a given laboratory. It is anticipated that any changes in agency personnel systems would be accomplished, over time, within existing budget resources and be the basic for improving the use of those resources.

(A similar bill was introduced in the U.S. Senate by Senators Bingaman, Goldwater, Nunn, Quayle, Chiles, Wilson, Gore, and Rockefeller.)

Lewis Receives 4 Awards For New Technical Products

NASA Lewis Research Center has garnered four Research & Development magazine's IR-100 awards in this year's contest to select the 100 most significant new products developed during the past year.

Selections were made by a blue ribbon panel of technical judges from more than 1,000 entries submitted.

The award-winning products are Servomechanism for Propeller-Pitch Change, Transmit Module, Communications Traffic Processor and Rotary Power-Transfer Device, developed jointly by Lewis and industrial companies under contract to the Center.

NASA Lewis researchers Stuart H. Loewenthal of Avon Lake and Bruce M. Steinetz of Strongsville plus General Electric engineers developed the Servomechanism for Propeller-Pitch Change. The product can accurately control the propeller blade angle of large (10,000-kilowatt) turboprop aircraft propellers over the complete spectrum of flight operating conditions. With certain modifications, the new product can be adaptable for applications as aircraft wing pivot mechanisms, tank turret aiming actuators and other heavy mechanisms requiring very accurate pointing and tracking control.

Developed by Lewis researchers Thomas J. Kascak of Lakewood, Godfrey (Art) Anzic and Denis J. Connolly of North Olmstead, and Rockwell International engineers, the Transmit Module is used to provide rf signal amplification and phase shifting at a frequency of 20 gigahertz. It is of monolithic design in which all module functions are contained on a single 6.4 × 4.8 millimeter semiconductor chip with the smallest circuit feature size of about 40 millionth of an inch. Development of the Transmit Module technology makes possible the production of weight and cost effective advanced phased array antenna systems for future communications satellite systems.

NASA Lewis engineer Russel J. Jirberg of Parma, together with electronics engineers from Motorola Corporation of Scottsdale, Arizona have developed a Communications Traffic processor for the next generation of communications satellites. The new system provides the capacity and routing flexibility needed to handle the nation's growing demands for telephone and computer message traffic. When used aboard satellites having multiple narrow beam antennas, this "switchboard in the sky" will enable more than 60,000 individual voice messages, video pictures and computer data to be routed directly among users throughout the country equipped with low cost ground terminals.

A Rotary Power-Transfer Device, which transfers electrical power through a rotating joint, was developed by Lewis engineer David D. Renz of Litchfield in cooperation with Sperry Flight Systems engineers. The device is a low loss spacetype design capable of transferring high power (hundreds of kilowatts), AC or DC, to frequencies such as 20 kHz. Loss of only 22 watts per circuit while transferring 100 kilowatts is one of its outstanding features. The roll-ring assembly device has the potential to be one of the major components of the Space Station and other spacecraft where large amounts of power are required, according to the developers.

NASA Lewis has earned the coveted IR-100 award every year except one since first entering the competition in 1966, and ranks fifth as the all-time winner with 48 awards.

NSTL Selected As Location For ITD Remote Sensing Center

Mississippi's Institute of Technology Development (ITD) was selected last month by NASA to establish a national Center for the Commercial Development of Space at NSTL.

The institute is one of only five centers nationwide to receive NASA incentive grants for research to promote and stimulate space technology commercial applications. NASA will initially fund the Centers for a period not to exceed five years at which time they are expected to be self-sustaining. Funding will range from $750,000 to $1.1 million on a year-to-year basis with further funding dependent upon a favorable annual review of progress in stimulating commerical ventures in space.

According to Isaac Gillam, assistant administrator for Commercial Programs at NASA Headquarters, the research of each of the Centers will eventually lead to the development of new products which either have commercial potential or contribute to possible new commercial ventures.

Ultimately the Remote Sensing Center for Commercial Development will be housed in the future Mississippi Technology Transfer Center to be located in the central engineering and administrative complex at the installation. The $4 million Transfer Center was funded by the state legislature in April to promote high technology research and provide a means for transferring that research to businesses in the public and private sectors.

According to NSTL Deputy Director Roy Estess, the Center will initiate operations at the Installation in early October.

ITD is a private, non-profit organization devoted to improving the economy of the state by bringing high technology jobs into Mississippi. Operations began in February with funding primarily from the Department of Commerce and the state legislature.

The Mississippi technology institute competed with 20 other applicants for the five commercial space projects which received the NASA grants.

The other centers awarded grants were the Battelle Columbus Laboratories in Ohio; the University of Alabama at Birmingham; the University of Alabama at Huntsville; and Vanderbilt University in Nashville, Tenn.

NASA STEERING COMMITTEE MEETS AT MERCK, SHARP & DOHME

On October 9-10, 1985, the NASA Productivity Steering Committee held its fifth meeting at Merck, Sharp & Dohme (MSD) research laboratories in West Point, Pennsylvania. The Administrator, Mr. James M. Beggs chaired the group. The committee consists of the field installation directors, the associate administrators, and the Director of NASA Productivity Programs. The evening before the meeting began, the committee was briefed by General William L. Creech, USAF-Retired, who made a presentation on his management experiences while Commander of the USAF Tactical Air Command for 7 years. General Creech was featured in Tom Peters' book, **A Passion for Excellence.** On October 9, the group was briefed by the President of MSD, Douglas J. MacMasters, and his executive staff on productivity and quality improvements at MSD. The second day was a closed meeting of the steering committee. The workshop discussions and briefings centered around approaches to: (1) increase equipment and facility modernization; (2) increase flexibility of managers by reducing rules and regulations; and (3) streamline the decision-making process through greater delegation. In addition, the proposed NASA Productivity and Quality Improvement Demonstration Project was reviewed. The attendees pictured are: (front row—left to right) James Sideler-**MSD,** Frank Penaranda-**HQ,** Jerry Hlass-**NSTL,** William Ballhaus-**ARC,** Thomas Gaspar-**MSD,** Louis B. DeAngelis-**HQ;** (second row) Andrew Stofan-**LeRC,** C. W. Cottone-**MSD,** Dr. Franklin Martin-**GSFC,** Frederick Povinelli-**HQ,** H. William Wood-**HQ,** Gene Guerny-**HQ,** Nathaniel B. Cohen-**HQ,** Richard Clark-**MSD;** (third row) Dr. Noel Hinners-**GSFC,** Dr. Harriett Jenkins-**HQ,** Michael Weeks, **HQ,** Dr. William Lucas-**MSFC,** Philip E. Culbertson-**HQ,** Richard Serafin-**MSD,** David R. Braunstein-**HQ,** Gerald Griffin-**JSC;** (fourth row) Thomas D. O'Connor-**MSD,** Richard Smith-**KSC,** LeRoy Hopkins-**HQ,** Robert Smith-**HQ,** Joyce Jarrett-**HQ,** Samuel Keller-**HQ,** Dr. Milton Silveira-**HQ,** Thomas Newman-**HQ,** and James M. **Beggs-HQ.**

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NASA's International Affairs

. . . Ken Pedersen

I am delighted to have this opportunity to share with the many readers of NASA ACTIVITIES some thoughts about our agency's international activities. NASA's commitment to incorporating international participation in its programs is deeply grounded in both policy and practice. The 1958 Space Act, the agency's fundamental charter, specifically instructs NASA to conduct its activities "so as to contribute materially to . . . cooperation by the United States with other nations and groups of nations." By almost any reasonable measure, NASA has successfully implemented this expression of legislative intent.

Since 1958 we have concluded over 1,000 agreements with over 100 countries and international organizations. In fact, few NASA space programs have gone forward without an international dimension. These agreements have governed cooperative partnerships ranging from the collection and sharing of ground truth by a single scientist through the development of complex, expensive hardware elements such as the European Spacelab, which required nearly a decade and over $1 billion to complete. Indeed, coping with the diversity of these relationships, involving individuals and institutions from both developed and developing countries, is one of the most rewarding and challenging aspects of the program. Because international cooperation is such a pervasive feature of NASA's way of doing business, I suspect there are few NASA employees in Washington and at the Centers who have not been touched in some manner by our worldwide activities.

I believe that NASA has benefitted greatly by taking a global view of its program responsibilities. Moreover, these benefits have not been NASA's alone, but have accrued to the nation as a whole. The benefits received by the U.S. through international civil space cooperation take several forms. Cooperative partners share the cost of projects so that the country benefits from receiving free mission-related hardware and support that we might otherwise have to fund ourselves or do without. Over the years, the value of foreign contributions to NASA projects amounts to nearly $3 billion.

Cooperation also pays off in other ways. International participation has enhanced the scientific return of our space missions and has given us access to data acquired by the growing number of programs being mounted abroad. Through international arrangements, we have gained access to locations abroad which are essential to the safe, effective conduct of our activities. Each time the Space Shuttle flies, for example, it benefits from the availability of tracking facilities and emergency landing sites located around the globe. NASA's international activities also contribute to broader U.S. foreign policy objectives by strengthening relationships with allies and friends and bolstering worldwide respect for U.S. technological achievements.

One of the most absorbing aspects of working in the international arena is the constantly changing nature of the landscape. While some principles must remain more or less fixed, flexibility in both policy and implementation also is necessary. Continuing to insist that each project stand on its own merits and be subject to a specific, carefully written agreement is a principle worth retaining. So too is the principle requiring that each partner develop a discrete piece of the project with their own funds and technology. This "clean interface/no exchange of funds" approach not only simplifies management structures, which are already complicated enough in most international undertakings, but helps each partner to limit the transfer of its valuable technology.

At the same time, changes in the international arena will undoubtedly require NASA to adapt some aspects of its philosophy accordingly. The increasing significance of space as a workplace subject to intense commercial competition means that the number of opportunities for intergovernmental cooperation may decrease as appropriate concerns for proprietary advantage and protection grow. Also, the growing number of countries and organizations with developed space capabilities almost certainly means that where cooperation does emerge, it will be increasingly multilateral rather than bilateral and decreasingly dominated by the U.S. On NASA's part, this will require a heightened willingness to engage potential foreign partners in early mission planning activities, to share management and operational authority, and to accept junior partner status in some cases. I believe these trends are inevitable and even healthy.

Glimpses of NASA's efforts to respond productively to these developments are already visible. In the case of Space Station, for example, we initiated a coordinated planning and information sharing process on a no-commitment basis with the Europeans, Japanese and Canadians fully 2 years before formal presidential approval for the project was obtained. This allowed our potential partners to play an active role in shaping a

project in which their ultimate investment could run to many billions of dollars and placed us in a position to move out quickly together when the President, Congress and appropriate governmental bodies abroad gave the political green light. In a similar vein, NASA has expressed to its future partners a willingness to share management responsibility for the Station to a degree commensurate with their financial investments and commitment to long term utilization, keeping in mind the need for efficient management practices.

In space science, as well, NASA is seeking to strengthen our multilateral early planning mechanisms and to promote missions where all partners contribute more or less equally to the project, sharing in its execution and results. For example, NASA and its most frequent scientific partner, the European Space Agency, (ESA), now have regular semi-annual meetings between their respective space science directorates to explore proposed missions and identify whether they can be improved and made more efficient through cooperation. One proposed, though not yet approved program called the International Solar Terrestrial Physics Program would combine the efforts of NASA, ESA and the Japanese Space Science Agency to mount a multi-satellite mission to study the complex interaction between the Earth and its nearest star, the Sun. The financial investment of the Europeans and Japanese would approximately equal that of NASA and a successful mission would require close management coordination by all partners.

Very shortly, Halley's comet will be returning to Earth's vicinity. Much has been made in some quarters about the decision not to send a U.S. spacecraft to accompany spacecraft being sent to meet the comet by ESA, Japan and the Soviet Union. NASA is, however, playing an active role in providing deep space tracking support to these spacecraft and in coordinating an extensive ground-base observer network called Halley Watch. NASA also will share fully in the scientific results of the foreign missions. The Halley arrangement demonstrates clearly that even in those selected cases where NASA cannot assume a leadership role, it can benefit significantly by participating in a supporting relationship. This is, in my judgement, an appropriate division of labor that recognizes the realistic resource limitations under which all countries must operate.

As NASA moves forward, we will do well to keep in mind that competition, which will surely grow, is not inconsistent with cooperation. The same capabilities that make foreign countries increasingly able competitors also provide a basis for even more equitable and reliable cooperative programs in the future. NASA's challenge is to continue using good judgement in selecting and structuring cooperative arrangements with the objective of maximizing our returns and minimizing risks, assuming always that our partners are doing the same. The most durable and satisfying international arrangements are those where potential collaborators, operating out of enlightened self interest, define and act upon their overlapping areas of mutual benefit.

In the months ahead, we will continue to see earlier seeds of cooperation bearing rich fruit. The encounter with Comet Halley, the Galileo mission to Jupiter, the Ulysses flight over the poles of the Sun, the launching of the formidable Hubble Space Telescope, new and exciting Spacelab missions and more inspiring performances from the Shuttle's Canadarm will all testify to the good health and richess of NASA's international cooperative programs. And there is much more to come, with the Space Station, in particular, promising to be the largest and potentially most rewarding international project yet conceived. It's been a pleasure, and down right good fun, to be a part of it all.

(Ken Pedersen will spend the next year on sabbatical as research professor at the Georgetown University School of Foreign Service, Washington, D.C.)

Heard From Around The World

. . . (from non-NASA sources)

China—Reporting results of its sixth 5-year plan, a Chinese bureau listed the country's achievements in space technology since 1981. These included launching carrier rockets into the Pacific Ocean target area, positioning an experimental communications satellite, and carrying out a submarine-based rocket launching test to the designated sea area.

India—Early next year, India will launch a satellite to conduct experiments on gamma ray bursts and emissions from celestial bodies. The satellite will be launched by the Augmented Satellite Launch Vehicle from Sri Harikota.

Italy—Italian and West German industry have established a company called Interspace for the joint commercial utilization of space with a view towards opening the market of space to industry and science. On the international level, Interspace will operate either as a development company or as a company promoting and mediating between the space industry and the user industry.

Services offered range from consultancy and mediation to research and development, commercial production in space, and marketing of joint launching systems.

MBB-ERNO of Bremen and Aeritalia of Turin established the company. Company rules provide for major interests to be controlled by other partners.

Japan—The Ministry of International Trade and Industry (MITI) will begin a project in fiscal 1986 to develop a free-flyer, unmanned, space experiment system. Jointly promoted with the private sector, the 1- to 2-ton free-flyer will be launched into space and retrieved by U.S. Space Shuttles.

Expected to begin in 1992, experiments will address development of alloys, high-polymer materials and other structural materials, biotechnology, computers and telecommunications. MITI estimates total development costs to be 94.3 to 141.6 million dollars.

Did You Know?

The National Aeronautics and Space Act of 1958 authorizes the Administrator to grant monetary awards to NASA and its contractor employees for scientific or technical contributions determined to have significant value in the conduct of U.S. aeronautical and space activities.

During Fiscal Year 1985, the Administrator, upon the recommendations of the Inventions and Contributions Board, granted awards of $1,000 or greater to innovators of 25 contributions. These awards were highlighted by a $20,000 award to Robert Nathan, of the Jet Propulsion Laboratory, for his "combined technical contributions to planetary and biomedical image processing and scientific data analysis techniques."

The total value of awards granted during Fiscal Year 1985 was $281,300. During this period 1,486 individual awards were granted, 529 to NASA employees and 957 to NASA contractor employees. Dollar value of the awards ranged from $100 to $20,000. Each monetary award is accompanied by a NASA Certificate of Recognition.

An objective of the Space Act Awards program is to provide an incentive to identify, document and disseminate scientific and technical contributions to U.S. industry and other government agencies. This important objective supports the transfer of NASA aeronautics and space technologies to the public sector, ultimately to the benefit of U.S. citizens.

The world's fastest and most powerful supercomputer, the Cray-2, has arrived at NASA's Ames Research Center. The new machine can perform 250 million continuous calculations per second, more than three times faster than the previous generation of supercomputers. It will allow major steps toward simulating actual aircraft flight on a computer. It will make possible important advances in aircraft design, in both cost savings and aircraft performance. It is also unique in that it has a huge memory capacity of 256 million 64-bit words.

The new supercomputer is the first major building block in the creation of NASA's Numerical Aerodynamic Simulation (NAS) program, planned to provide the world's most powerful large scale, high speed processor system. In addition to its important advantages for aircraft design, NAS represents a major national facility in such research areas as aerothermodynamics computational chemistry, atmospheric modeling and other computationally intensive scientific applications.

Below, the Cray-2 Supercomputer is being inspected during installation by (from left to right) Richard H. Petersen, Langley Center Director; William F. Ballhaus, Jr., Ames Center Director; Dale L. Compton, Ames Deputy Director; Paul F. Holloway, Langley Deputy Director; Raymond S. Colladay, OAST Associate Administrator; John M. Klineberg, Lewis Deputy Director.

Contractor News

Lewis Research Center awarded **General Dynamics Corp., Convair Division,** San Diego, California, a $79,194,665 contract in support of the Shuttle/Centaur program for the period August 30, 1985 through June 1987.

Under the cost-plus-award-fee contract, General Dynamics will supply labor, materials and resources necessary to provide management and engineering services plus launch operations services necessary to implement the Shuttle/Centaur program.

Included in this multi-contract concept are services such as overall program management; administration and engineering support; technical management; operations, planning and integration and launch complex modifications.

Work will be performed at the contractor's plant in San Diego and at the Eastern Launch site in Florida.

NASA signed an agreement with **Scott Science and Technology, Inc. (SST),** Lancaster, Calif. to provide technical expertise to SST in the development of a commercial liquid-fuel upper stage for boosting Shuttle-deployed satellites to geosynchronous orbit.

The agreement, signed under NASA's Commercial Use of Space Policy, will run for 21 months.

SST's upper stage, called the Satellite Transfer Vehicle, has been in privately-financed development for 2 years. The stage will have the capability to boost satellites, ranging from 2,000 to 19,000 pounds, to geosynchronous orbit. In some types of missions, the stage would be recoverable.

Engineers at NASA's Johnson Space Center, will monitor the stage's development and will consult with the SST staff on technical problems. SST will reimburse NASA for the use of any test facilities, salaries and travel by JSC personnel.

1985 Shuttle Launch Schedule

Mission	Date/Orbiter	Payloads	Crews
61-B	Nov. 26, 1985	Morelos-B	Shaw, CDR
	Atlantis	Satcom KU-2	O'Connor, PLT
		Aussat-2	Cleave, MS
		CFES	Spring, MS
		EASE/ACCESS	Ross, MS
		IMAX	Vela, PS (Mex.)
		GAS (1)	Walker, PS
		DMOS	
61-C	Dec. 18, 1985	Satcom KU-1	Gibson, CDR
	Columbia	MSL-1	Bolden, PLT
		HH-G1	Chang-Diaz, MS
		IR-IE	Hawley, MS
		SSIP (3)	Nelson, MS
		IBSE	Cenker, PS
		CHAMP	Nelson, PS
		GAS Bridge	

1985 Expendable Launch Schedule

Mission	Launch Date	Vehicle	Launch Site
AF-17	Oct.-Dec.	Scout	WFF
NOAA-G	Nov.	Atlas	WSMC
GOES-G	Dec.	Delta	ESMC
Navy-23	Dec.	Scout	WSMC

*** Launch Sites:** KSC — Kennedy Space Center, Fla.; ESMC — Eastern Space and Missile Center, Fla.; SMR — San Marco Range, Indian Ocean; WSMC — Western Space and Missile Center, Vandenberg Air Force Base, Calif.; WFF — Wallops Flight Facility, Wallops Island, Va.

Another Dividend from Air and Space

Research and development in aeronautics and space have provided numerous benefits for all Americans — and at a tiny percentage of the tax dollar. Here is an example:

Workplace Design

In designing the interior of the Space Shuttle NASA encountered a number of considerations that demanded a different approach from earlier spacecraft design. The orbiter would be the largest spacecraft ever built and would carry more people than prior spacecraft. Missions would involve more motion within and outside the spacecraft, the type of work would differ from earlier experiences and crews would include persons of both sexes. Also, many of them would be non-pilots and most of a different age bracket than earlier astronauts. These and other factors affected design criteria for crew clothing, equipment, workplace and living quarters. Johnson Space Center (JSC) felt that the many new design considerations demanded a broader data base on anthropometry, the study of the size, shape and motion characteristics of the human body.

JSC therefore initiated a project to assemble the information available worldwide and produce a centralized collection of anthropometric knowledge. The result was the three-volume *Anthropometric Source Book*, compiled and edited under JSC contract by Webb Associates, Yellow Springs, Ohio.

Designed primarily for use by NASA, the military services and aerospace contractors, the book was also intended to help non-aerospace engineers, architects and others engaged in design of clothing, equipment and workplaces. The work has won considerable acclaim as an important addition to Human Factors Engineering and it has spawned a number of non-aerospace spinoff applications.

An example is its use by Eastman Kodak Company, Rochester, New York, whose Human Factors Section of the Health Environment Laboratory has several sets of the *Anthropometric Source Book*. They use the data frequently for such purposes as designing protective clothing studying placement of controls on Kodak EKTRAPRINT copiers/duplicators, or designing workplaces. The latter use is exemplified by the company's application of the NASA data to design of efficient, productive and comfortable workplaces for employees in the Rochester (New York) processing laboratories. In designing these workplaces, where employees process disc film negatives before sending them to the printing area, Kodak's Human Factors Section used the source book to determine such dimensions as leg space, work surface height and thickness, employee reach distances, proper height for the computer terminal screen, seat height and knee space. The type of workplace that emerged from the design effort is shown in the photo below.

* NASA does not endorse commercial products developed as a result of its Technology Utilization or Patent Licensing Programs, but it does encourage the widest possible use of its technology.

*U.S. GOVERNMENT PRINTING OFFICE: 1985-491-575:20004